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[c8] 8. The method of claim 7 wherein the filter bank and the intermediate filter bank satisfies an equation in accordance with

$$G(z)^T = (z^{-d} \ 0 \ \dots \ 0) F_a^{-1}(z) V^{-1}(z^M), \text{ wherein } G(z) \text{ represents a synthesis filter}$$

bank $F_a(z)$ is an aliasing component matrix of the sensitivity profiles F , z^{-d} is a time delay, V is an additional filter bank inserted between the decimation stage and the interpolation stage for stability and M is a decimation factor.

[c9] 9. The method of claim 1 wherein the at least one image is substantially free of aliasing and amplitude distortion

[c10] 10. The method of claim 1 wherein the sensitivity profiles of the array are overlapping and further comprising the step of applying a lapped transform to the detected signals during the processing step.

[c11] 11. The method of claim 1 wherein the array is a strip array comprised of a plurality of array elements each element being a linear strip.

[c12] 12. The method of claim 1 wherein the array comprises a strip array of a plurality of conductive strips, each strip having a corresponding phase relationship to a spatial location within an object to be imaged in the MRI system and the processing step comprises encoding each of the corresponding phases to reconstruct the at least one image.

[c13] 13. A parallel Magnetic Resonance Imaging (MRI) system comprising:
an array of magnetic resonance (MR) detector coils arranged in an array for detecting a plurality of MR signals, each of the coils having a corresponding spatial sensitivity profile;
a processing means for processing the plurality of MR signals with at least one filter bank to reconstruct at least one image.

[c14] 14. The parallel MRI system of claim 13 wherein the array of MR detector coils comprises a spatial filter bank formed with the respective sensitivity profiles for spatially filtering the plurality of detected MR signals.

[c15] 15. The method of claim 14 wherein the detector coils are arranged to optimize the spatial encoding of the spatial filter bank.

[c16] 16. The parallel MRI system of claim 13, further comprising
a decimated gradient encoding system to generate a plurality of the decimated MR signals; and,
an interpolating system for interpolating the plurality of decimated signals to generate a plurality of interpolated signals; and
at least one of a lapped transform and a synthesis filter bank to reconstruct interpolated signals .

[c17] 17. The parallel MRI system of claim 16 wherein the decimated gradient encoding system comprises reduced phase encoding steps.

[c18] 18. The parallel MRI system of claim 17 wherein the decimated gradient encoding comprises collecting subsets of non-rectilinear trajectories in k space, the subsets including at least one k space, the subsets including at least one of a reduced number of interleaves of an interleaved-spiral trajectory and a reduced number of radial lines of a radial trajectory.

[c19] 19. The parallel MRI system of claim 13 further comprising:
an intermediate filter coupled between the decimated gradient encoding and the interpolating system, the intermediate filter stabilizing the processing means for reconstructing the at least one image.

[c20] 20. The parallel MRI system of claim 19 wherein the filter bank and the intermediate filter bank satisfies an equation in accordance with
$$G(z)^T = \begin{pmatrix} z^{-d} & 0 & \dots & 0 \end{pmatrix} F_a^{-1}(z) V^{-1}(z^M),$$
 wherein $G(z)$ represents a synthesis filter bank, $F_a(z)$ is an aliasing component matrix of the sensitivity profiles F , z^{-d} is a time delay, V is an additional filter bank inserted between the decimation stage and the interpolation stage for stability and M is a decimation factor.

[c21] 21. The parallel MRI system of claim 13 wherein the at least one image is substantially free of aliasing and amplitude distortion.

[c22] 22. The parallel MRI system of claim 13 wherein the sensitivity profiles of the array are overlapping and further comprising the step of applying a lapped transform to the detected signals during the processing step.

[c23] 23. The parallel MRI system of claim 13 wherein the array is a strip array comprised of parallel strips of conducting material connected to a ground plane by capacitors.

[c24] 24. The parallel MRI system of claim 13 wherein the array comprises a strip array of a plurality of conductive strips, each strip having a corresponding phase relationship to a spatial location within an object to be imaged in the MRI system and the processing step comprises encoding each of the corresponding phases to reconstruct the at least one image.